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16th International Command and Control Research Technology Symposium (ICCRTS) June 2011 Overseas Visit Report

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ABSTRACT

The 16th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011 in Canada. The theme was "Collective C2 in Multinational Civil-Military Operations." This year's symposium explored the C2-related responses to these changes and challenges. Five Joint Operations Division papers were accepted for presentation. This general document outlines this conference, the JOD presentations and provides feedback from the ICCRTS conference Chair.

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16th International Command and Control Research Technology Symposium (ICCRTS) June 2011 Overseas Visit Report

Executive Summary

The 16th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011. The theme was "Collective C2 in Multinational Civil-Military Operations." This overseas visit report provides an overview of ICCRTS 2011. Including the three primary research areas that emerged from the conference of:

- agility and what that means for organisational structures;
- the concept of "Harmony of Purpose"[1]; and
- the need to develop better approaches to discovery of second and tertiary effects to decision making, operational analysis and nation building.

This is followed by an overview of the plenary sessions, and the topics of the parallel track presentations. Additionally the abstract and associated audience questions from the Joint Operational Division (JOD) of Defence Science and Technology Organisation (DSTO) presentations delivered is included.

ICCRTS Chair, Dr Alberts praised the consistently high standard of presentation and papers of JOD DSTO. He noted the challenges in presenting effectively across such a diverse range of topics. Another point Dr Alberts noted was the value he saw in the different types of presentations which JOD offer each year. These aligned with his view of the purpose of the conference.

Finally the report makes some recommendations for future ICCRTS considerations for JOD DSTO.

[1] This is not a new concept – but it appears to be gaining traction within the ICCRTS community.

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1. Background

The 16th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011. The theme was "Collective C2 in Multinational Civil-Military Operations."

Since the first ICCRTS in 1995, extensive changes have occurred in the international environment, in the nature of threats to national security, in the missions undertaken to protect our security, in the technologies available to support our endeavours, and in the ways the functions associated with command and control are carried out. This year's symposium explored the C2-related responses to these changes and challenges.

2. Overseas Visit Report

This overseas visit report provides an overview of ICCRTS 2011. This includes the three primary research areas that emerged from the conference from my perspective. This is followed by an overview of the plenary sessions, and the topics of the parallel track presentations. A Also included are the abstract and associated audience questions from presentations given by the Joint Operations Division (JOD) of Defence Science and Technology Organisation (DSTO). Finally the additional aspects of the trip are summarised under other business and include some information on trip preparation, feedback from ICCRTS Chair and recommendations for future ICCRTS attendance.

From my perspective, based on the sessions I was able to attend, the three primary research areas that emerged across the conference were:

- The idea of agility and what that means for organisational structures featured in many presentations. This remains an ongoing area of research for this community.
    - Plenary Dr Alberts
    - Papers 068, 072, 146, 052, 106, 064

- The concept of "Harmony of Purpose"[1] (rather than unity of command) as applied to complex endeavours. In particular, a Swedish presentation (092) had many links across the civil – military community (disaster relief) as well as those interested in coalition operations.
    - Primarily paper 092
    - Track 10 and part of track 8
    - Plenary Mr Roy Johnson (briefly)

- The need to develop better approaches to discovery of second and tertiary effects to decision making, operational analysis and nation building. Many authors identified that this remains an area of research for their nations. This included issue such as how

[1] This is not a new concept – but it appears to be gaining traction within the ICCRTS community.

to undertake and develop analysis, models and visualisation, and so make informed predictions.

- Plenary Mr Pontius
- Plenary Dr Alberts

The absence of papers examining Socio-technological approaches is noteworthy. There were several that explored the technical aspects but most identified the "socio" aspects as remaining an area of "work in progress". This issue was commented on during the "wrap up" plenary.

3. Plenary Presentations

Day 1 Tuesday 21 June opened proceedings with Welcoming addresses from Dr Guy Vezina (Canada) and Dr David Alberts (US) Conference Chair. These were followed by three plenary presentations.

3.1 C2 Challenges and a Way Ahead: Mr Ronald Pontius Director C2 Programs and Policy OASD (NII)

The primary thrust of this paper was the DoD Netcentric Data strategy based on visible, assessable, understandable and trustable data. The speaker expanded on the historical aspects of "data hugging" where the need to know construct had limited data exploitation. However he did not offer any suggestions for moving from the "data hugging" to the "open sharing" primary perspectives. The presenter identified three tiers of joint mission threads – tier 1 capability gaps, tier 2 exercises and tier 3 mission rehearsal and how this aligns with thinking about the 4W's (who / what / when / where) elements of data / information / knowledge and its accessibility were also expanded on at length.

3.2 Measuring Agility: Dr David Alberts Director Research OASD (NII)-DoD CIO

The primary theme for this plenary paper was how perspective shapes the way that agility is understood and measured. With examples from systems thinking, entity, activity and organisational perspectives were used to illustrate his views of the many valid perspectives of measuring and visualising agility. Dr Alberts identified that different approaches are required for different situations to be seen as "successful" and that this success was different in effect, scope and exploits for these different contexts. Different C2 structures (from hierarchal / edge / coordinated / collaborative) were shown to work in different contexts. Examples included the allocation of discussion / decision space, evaluating interaction patterns and dissemination of information.

3.3 Information Sharing in Complex Endeavours: Mr Roy Johnson Director Integrated ICT support OASD (NII)-DoD CIO & Mr Garard Christman Program Manager and Senior Systems Engineer Femme Comp Inc (FCI)

This presentation focused on situational awareness for decision support, specifically in the unclassified information sharing (UIS) context. Disaster relief examples were provided where there are many organisations to coordinate, a diverse set of actors, several types of C2 structures and the need to facilitate bi-directional information sharing. There were also comparisons made with commercial information intelligence systems used by companies like AMAZON (originally an online book seller's business model) and how that data collection can be utilised for other purposes. Collecting information about transactions/ actions to improve the corporate agility, co-ordination etc are the aim of FIST (smart phone application) which is to be uploaded for situational context utilising the power of the crowd concept with an example of Haiti and SMS TXT. This FIST application is interesting as it is an application which was described as easy to share, easy to use and provides linkages into extant US military systems. For DSTO this has implications for our disaster relief, CIMIC and FJOC activities.

4. Topics of the Parallel Track Presentations

The 16th ICCRTS was comprised of tracks on various topics:

1. concepts, theory and policy
2. approaches and organisations
3. information and knowledge exploitation (detection / collection/ instrumentation)
4. information and knowledge exploitation (discovery / access / sharing / processing of existing)
5. collaboration, shared awareness and decision making
6. experimentation metrics and analysis
7. modelling and simulation
8. architectures, technologies and tools
9. networks and networking
10. C2 management and governance in Civil-Military Operations
11. cyberspace management

Each presentation was allocated 30 minutes: 20 minutes to present, 5 minutes for questions and discussion, and 5 minutes to allow individuals to move to the next presentation of their choice.

JOD provided five papers within three of topic areas:

- **Topic 2: Approaches and Organizations:** This examined designing, analysing, and implementing various approaches to focus and convergence (e.g., C2, management, governance). This topic area contained a wide spectrum of papers from "initial thoughts" through to detailed results and implications for Defence.

- **Topic 7: Modelling and Simulation**: which encompassed models and simulations that represent emergent behaviours in C2. Most of the papers in this topic area were theoretical, exploring initial ideas and hypothetical situations in the unclassified domain.
- **Topic 9: Networks and Networking**: this topic area addressed social or socio-technical as well as communications and information networks and networking behaviours. Of interest is interoperability in the context of complex endeavours which require new (inter)organizational and process models that reflect the complexity of collective operations and behaviours, and the development and application of appropriate standards.

5. JOD DSTO Presentations

In preparation for ICCRTS, DSTO Canberra held a "mini ICCRTS" day which allowed each author to present their paper to the JOD audience. This approach was commended by Dr Alberts and some of the Topic Chairs. They queried whether this might provide opportunity to contact the wider community of researchers in future years.

I gave each of the five JOD presentations based on material developed by the paper authors. While I had developed a working knowledge of topic covered in those papers for which I was not an author, I recommended that the audience engage the authors directly if they had detailed questions.

Dr Alberts and the Topic Chairs commented that the JOD DSTO papers demonstrated a good balance across the spectrum of "student / new starter" to "work in progress" and "conceptual" with the depth and rigour commented. The abstracts from the five papers are provided below. A point of contact was provided for further information.

5.1 Paper 174 (POC: Irena Ali) "Coexistence or operational necessity: the role of formally structured organisation and informal networks during deployments. Track 2

The military faces an increasingly turbulent environment requiring flexibility and agility of organisational processes and structures. This is particularly prevalent for military forces interfacing with civilian organisations. Furthermore, the current military paradigm of network centric operations (NCO) is reliant on timely information flows, flexible command structures and adaptability to achieve mission outcomes. This paper reports on the findings and implications for organisational architectures and command and control of a study into the role of informal networks within a formally structured organisation in complex operational environments. Based on the analysis of two combat and one humanitarian deployments, this research examines whether informal networks contribute to military mission outcomes and what factors facilitate the co-existence of formal

organisational structures and informal networks during operational deployments. This analysis provides understanding of the prevalence and efficacy of informal networks during deployments, and their interaction with formal C2. The interrelationship between three emergent factors – accountability, autonomy and appropriateness of C2 arrangements – is necessary to harness the agility inherent in informal networks and the stability offered by formal structures. Doctrinal, command, and training implications of these findings are also discussed in this paper.

This paper was introduced by the chair (Dr Philip Farrell) as "one of my favourites of this track… it was beautiful to read". Participants were impressed with the quality and depth of data / robustness of the scientific research / rigour applied to the development of the analysis. Many had not seen this level of detail prior (they noted that interviewing 12 participants was considered robust in Dstl).

Questions from the audience included:

- When do formal C2 structures become informal and vice versa?
- Is there strategic C2 informal relationships and how were these presented / included?
- How to improve training to take advantage of the phenomena?

5.2 Paper 010 Anthony Dekker "Analyzing C2 structures and self-synchronization with simply computational models" Track 9

Although command and control is a complex activity, useful lessons aboutC2 can be learnt from simple computational models. In this paper, we describe experiments with two such models. The Kuramoto model, though with some serious limitations, provides a representation of information flow and self synchronisation in an organisation. A second (agent based) model, based on factorisation, provides a representation of planning that is slightly more realistic. These models suggest that the time for an organisation to reach a decision is related to the average distance in the organisational network, although our two experiments disagree on the nature of this relationship. Comparing the simulation results to empirical real-world studies confirms the relationship between time and the average network distance. Although the empirical studies suggest that this relationship is linear, the Kuramoto model might be more realistic in its suggestion of a non-linear relationship, since it captures the idea of information being attenuated during transmission by misunderstandings. The Kuramoto model therefore reveals a need for further empirical studies in this area.

Questions from the audience included:

- Can you describe the Kuramoto Model and underlying model assumptions?
- What are those limitations identified in the abstract?
- What is "to information being attenuated by Chinese Whispers as it spreads across the network"? the Q was really what are "Chinese whispers"
- Discussion between participants expanding into the relationship between the entities in the Kuramoto model

- What if the matrix is only partially disconnected? This built into a discussion on other related network information flows.

5.3 Paper 079 Sasa Baskarada "Towards a Semiotic Information Position Framework for Network Centric Warfare" Track 3

Semiotics is a field of study that deals with the relationships between representations, intended meanings, and interpretations of signs and symbols. As such, it is of particular relevance to a range of network centric warfare primitives, including data, information, knowledge, awareness, and understanding. In this paper, we apply semiotics to such primitives in the physical, information, cognitive and social network centric warfare domains from the syntactic, semantic, and pragmatic perspectives. As a result, we present the Semiotic Information Position (SIP) framework and evaluate it through a thought experiment involving a simple command and control scenario.

The chair noted this paper was considered for Best paper and spoke of the need to identify these new-starter / student papers, which bring alternative ideas into ICCRTS.

Questions from the audience included:

- Can you describe the difference between the Semiotic and semiology?

5.4 Paper 023 John O'Neill, Lydia Byrne, Cherylne Fleming, Duncan Byrne and Bede Galvin "Modelling and Assessing Air-Surface Integration" Track 2

Air-Surface Integration (ASI) is an important theme in the Australian Defence Force (ADF). This paper describes a systems analysis approach to ASI in an Australian context presenting ASI models that describe the structure, function, and behaviour of the ASI system. ASI is an inherently cross-boundary capability that emerges at the macro-system level integrating the components into a coherent system for coordinating, controlling and deconflicting operations in the air and on the surface. The boundaries that are crossed include airspace control measures, roles managing each airspace control measure, roles across services, roles across nations, and information flows across components. The paper describes how the ASI baseline model has been used to evaluate the current ADF ASI force structure capability and identifies socio-technical issues in the ASI system for capability designers.

Participants were again impressed with the quality of the scientific research applied to the development of the visualisations. These participants made the connection between the work by Irena and the work of the ASI team and commented on the short term nature of their tasking limited their research achieving such depth.

Questions from the audience included:

- Regarding formal and informal networks and Liaison officers
- Synchronisation of distributed C2 (battle rhythm)
- There were further discussions associated with visualisation representations; of particular interest was our use of different representations for alternative aspects of the problem (and how these can change as the researcher identifies more information about the topic). This aspect of representations is of interest to many in the international community.

5.5 Paper 055 Anthony Dekker "Game theory, adaptation and genetic programming: some perspectives on Operations Research for Counter IED" Track 7

This paper explores operations research issue is in the response to improvised explosive devices using the concept of a fitness landscape. In particular, we examine optimisation approaches that the share on a fixed fitness landscape for blue actions; game theoretic approaches where fitness is dissociated with the combination of red and blue actions; and approaches that are shared fitness landscapes are constantly changing as a result of red and blue activity. In particular, we examine the use of genetic programming. We discuss the strengths and weaknesses of these approaches with respect to an illustrative simulation model, and present experiments suggesting that genetic programming is a promising mechanism for exploring adaptivity in such simulation models.

Questions from the audience included:

- Have other fitness landscapes been explored?
- Is ~60% desirable? Even in hypothetical explorations?

5.6 Other presentations

Given six streams ran in parallel, I chose those presentations that appeared most relevant to the research interests of JOD. In cases where such papers clashed, I coordinated with Dr Fred Bowden (LOD) to ensure that we had better coverage of relevant material. The list of papers I attended are included in Table 1.

Table 1: List of papers attended during ICCRTS 2011.

Paper Number	*Title of Paper*
006	On optimising command and control structures
018	Multilingual context extraction extended with background knowledge for military intelligence
029	Web shared confrontation and collaboration analysis for civil military operations
037	A smarter common operational picture: the application of abstraction hierarchies to Naval command and control
042	Applicability of visual analysis to defence and security operations
045	Managing complex interoperability solutions using model driven architecture
056	Operational planning with uncertain and ambiguous information: command and control and the natural environment
063	Applying influence diagrams to support collective command and control in multinational civil military operations
064	Civil military incident command: integrating incident command systems and command and control to meet current emergency response demands
068	Innovating command and control training using visualisation technologies
085	Information design for synchronisation and coordination of modern complex multinational operations
089	Information fusion for collaborating commanders at different levels
092	Harmony rather than unity: a command concept for complex endeavours
106	Organisational agility model and simulation
117	Information sharing in emergency response
125	Optimisation based multilevel asset allocation model for collaborative planning
134	Towards a command and control poly-visualisation tool: leveraging the power of social network analysis and geographic information systems.
146	Plan failure analysis and plan adaptation the multilevel campaign planning
178	AEGIS International and ballistic missile defence: a new interoperability network

6. Other Business

6.1 Trip Preparation

The formal notification from JOD executive of my attendance was a unexpected (as I was not a lead author). In future years it would be helpful if when the papers are seeking approval, authors are asked to identify if they wish to be considered as the JOD presenter. This would allow supervisor(s) and the staff member involved to determine the impact on the work program and develop strategies to overcome problems that might arise.

Preparation for presenting the five papers required significant time to gain a sufficient working knowledge of the subject and ensure the key messages were able to be delivered in the allotted time. This included:

- Reading through the related conference papers;
- Engaging with the presenters on content (both quality and quantity), messages and key points, along with any questions I had; and
- Reading through some of the core background papers.

As such this preparation time was considerable. As such, time was not available during the normal work hours, so I undertook these activities out of hours. In future, I suggest that more time is made available to the JOD presenter to prepare for ICCRTS.

6.2 Feedback from the ICCRTS Chair

Dr Alberts praised the consistently high standard of presentation and papers of JOD DSTO. He noted the challenges in presenting effectively across such a diverse range of topics. I noted the use of an internal "mini ICCRTS" prior the conference, which allowed authors to present their paper(s), providing me with a good basis to effectively present their work. He supported this concept and expressed a desire to observe this in future, if at all possible. He suggested that next year we might look into making the JOD "mini ICCRTS" a VTC which would allow the presenters to engage with their fellows internationally more readily.

Another point Dr Alberts noted was the value he saw in the different types of presentations which JOD offer each year. These aligned with his view of the purpose of the conference. His groupings were "student papers / new starters" like that from Sasa Baskarada, "exploratory papers" based on new data or work in progress and "conceptual directional papers". This point tied into several of the conversations which the various chairs of the topics areas and I had had about the mixed sets of different papers with a spectrum of "readiness" for publication / peer review seen as perfect for this conference.

6.2.1 Other Information

It was announced during the conference that:

- Dr Albert's appointment ended in the fall (US autumn), future appointments were still in negotiations.
- Next 17th ICCRTS would be held in Washington next June (19-20-21 or 26-27-28 June 2012).

7. Recommendations

It is recommended that:

- JOD continue to use a "mini ICCRTS" prior to ICCRTS 2012 and consider inviting some of our primary allies to hear from the authors and ask the authors questions directly.
- ICCRTS presentation be scheduled as phoenix seminars to allow JOD peers to question the authors prior to "mini ICCRTS". These phoenix seminars could form part of the approval process for JOD major conferences.
- Authors should identify if they wish to be considered to attend ICCRTS upon submission of their abstract for approval.
- JOD DSTO appoints who is going to attend ICCRTS by Feb 2012 to allow plenty of time for OVA and other paperwork to be submitted.
- Each author provides an information pack for the JOD presenter including presentation (with detailed speaking notes) paper and core papers referenced by the author.
- JOD DSTO encourages papers from "students / recent starters" in addition to "work in progress" and "conceptual or directional" papers.
- JOD consider sending more that one presenter given the importance of this conference to JOD core business, the breadth of material covered, and the quantum of JOD presentation.

Appendix A: Participant List

Table 2: List of Participants from ICCRTS 2011

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Command and control conference

19. ABSTRACT

The 16th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011 in Canada. The theme was "Collective C2 in Multinational Civil-Military Operations." This year's symposium explored the C2-related responses to these changes and challenges. Five Joint Operations Division papers were accepted for presentation. This general document outlines this conference, the JOD presentations and provides feedback from the ICCRTS conference Chair.